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Simultaneous enhancement of *Chlorella vulgaris* growth and lipid accumulation through the synergy effect between light and nitrate in a planar waveguide flat-plate photobioreactor

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1 **Simultaneous enhancement of *Chlorella vulgaris* growth and lipid**
2 **accumulation through the synergy effect between light and nitrate in a**
3 **planar waveguide flat-plate photobioreactor**

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8 **Abstract**

9 Interval between adjacent planar waveguides and light intensity emitted from
10 waveguide surface were the primary two factors affecting light distribution
11 characteristics in the planar waveguide flat-plate photobioreactor (PW-PBR). In this
12 paper, the synergy effect between light and nitrate in the PW-PBR was realized to
13 simultaneously enhance microalgae growth and lipid accumulation. Under an interval
14 of 10 mm between adjacent planar waveguides, 100% of microalgae cells in regions
15 between adjacent waveguides could be illuminated. *Chlorella vulgaris* growth and
16 lipid accumulation were synchronously elevated as light intensities emitted from planar
17 waveguide surface increasing. With an identical initial nitrate concentration of 18 mM,
18 the maximum lipid content (41.66% in dry biomass) and lipid yield (2200.25 mg L⁻¹)
19 were attained under 560 $\mu\text{mol m}^{-2} \text{s}^{-1}$, which were 86.82% and 133.56% higher relative
20 to those obtained under 160 $\mu\text{mol m}^{-2} \text{s}^{-1}$, respectively. The PW-PBR provides a
21 promising way for microalgae lipid production.

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